st Engin.
Library
SEP 19 19

Volume 10 August, 1924 *Number 8*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of the Automatic Stoker

Care and Handling of Hydrostatic Lubricators

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS

For Automatic Stokers

BELOW we give a suggestive list of Texaco Lubricants for Automatic Stokers. This list covers the usual types of stokers in operation today but does not include the lubricants intended for steam cylinders. Those of our readers who are responsible for the operation of stokers driven by means of double acting steam engines will find a comprehensive list of Texaco steam cylinder lubricants on the inside back cover of this issue.

A judicious use of these recommendations will make possible the choice of the right oil for practically every automatic stoker condition.

For Enclosed Crankcase Stoker Engines of the Single Acting Type	TEXACO CRANKCASE OIL
For Crankcase of Stoker Engines of the Double Acting Type	TEXACO REGAL OIL
For Worm Gear Drives *(enclosed in oil-tight cases)*	TEXACO THUBAN COMPOUNDS OR TEXACO PINNACLE CYLINDER OILS
For Worm Gear Drives and Spur Gears *(Operating Exposed)*	TEXACO CRATER COMPOUND NO. 1
For Silent Chain Drives *(Chains submerged and bath lubricated)*	TEXACO TEXOL "E" OR TEXACO ALTAIR OIL
Chains enclosed but not submerged in oil *or where chains are exposed*	TEXACO THUBAN COMPOUNDS
For all Bearings of the Stoker requiring Grease Lubrication	TEXACO GREASE No. 3 OR NO. 5
For all External Bearings of Stoker Engines, Motors, etc., and Miscellaneous Bearings requiring oil lubrication	TEXACO TEXOL "C" OR "D" OR TEXACO ALEPH OIL

THE TEXAS COMPANY, U. S. A.

Texaco Petroleum Products

Dept. H, 17 Battery Pl., New York City

Atlanta	Chicago	El Paso	New Orleans	Oklahoma City	Pittsburgh
Billings	Dallas	Houston	New York	Omaha	Spokane
Boston	Denver	Jacksonville	Norfolk	Philadelphia	Salt Lake City

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

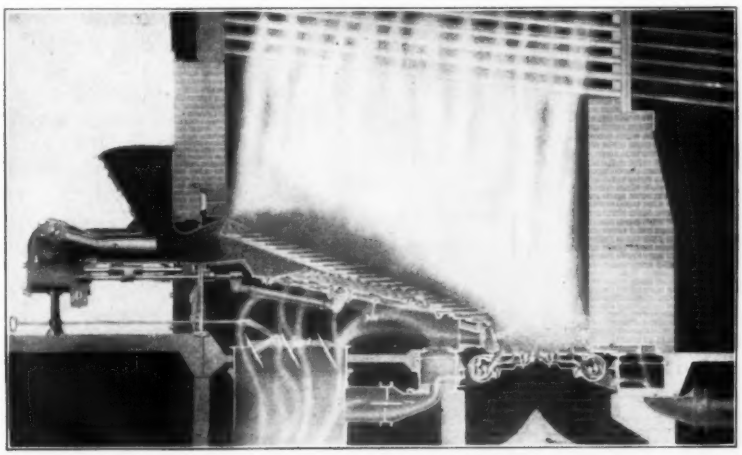
The Texas Company, 17 Battery Place, New York City

Copyright 1924, by The Texas Company

Vol. X August, 1924 No. 8

Change of Address: In reporting change of address kindly give both old and new addresses.

"While the contents of LUBRICATION are copyrighted, other publications will be granted permission to reprint on request, provided article is quoted exactly and credit given to THE TEXAS COMPANY."



Courtesy of Combustion Engineering Corp.

Fig. 1.—Longitudinal section through a typical underfeed type of stoker. The actual relation of the fuel and fuel bed to the operating mechanisms of the stoker is clearly shown.

Lubrication of the Automatic Stoker

FUEL conservation is one of the paramount features of modern boiler plant operation. It is, in fact, the keynote of efficient combustion, for boiler efficiency is directly dependent upon the amount of fuel burned in the evaporation of water into steam. Solid fuels are in general, more susceptible to wasteful handling and firing than either liquid or gaseous fuels; therefore, automatic means to improve this condition have been developed in the shape of the mechanical stoker.

The mechanism of the modern stoker is relatively simple in design, the driving unit being the essential part requiring lubrication. Individual manufacturers, however, employ various adaptations or types of drives according to the operating requirements of their stokers. In studying stoker lubrication we must as a result, look into the several designs or basic types in use today, inasmuch as lubrication will be materially contingent thereupon.

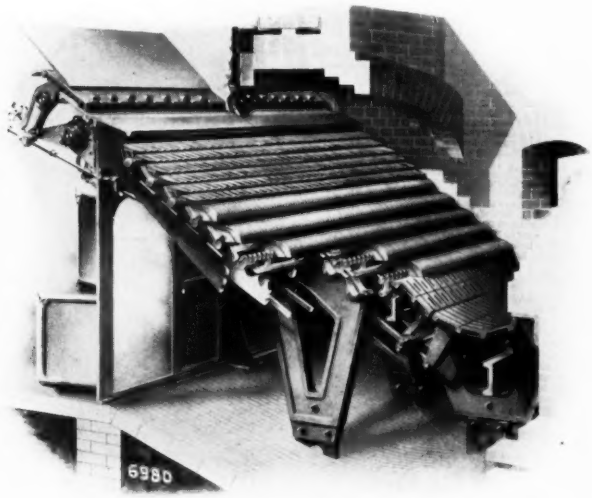
TYPES OF STOKERS

There are three distinct types of automatic stokers on the market, viz:

(a) The overfeed
(b) The underfeed and
(c) The chain grate or traveling stoker.

To a certain extent their names imply the manner in which coal is fed to the furnace. In the OVERFEED STOKER fuel is fed in at

either the sides or front end of the furnace through a hopper or magazine, being distributed along the top of an inclined set of grates. In the front feed stoker the grates slope towards the rear of the furnace, being set in one uniform plane. In the side feed furnace there are two sets of grates, each set sloping towards the center, making an angle or V at their lowest point.



Courtesy of Westinghouse Electric and Manufacturing Co.

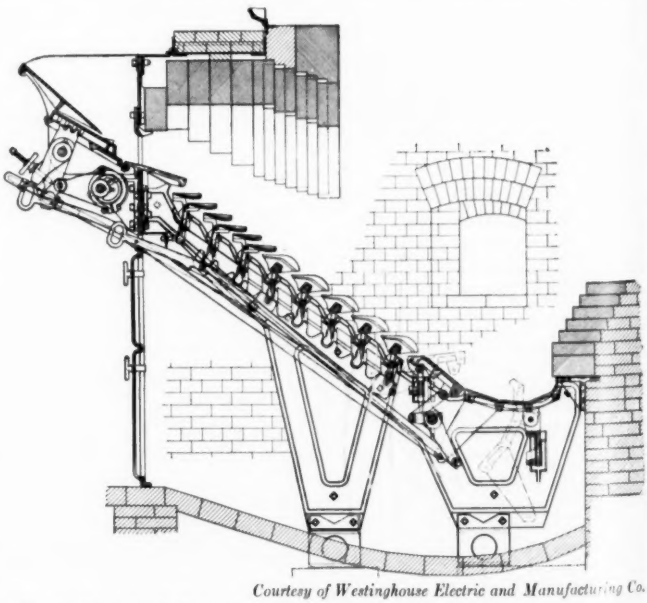
Fig. 2.—Sectional view, in perspective, of a mechanical stoker of the overfeed type. Details of grate construction are clearly shown.

Certain of the grates in an overfeed stoker installation move backward and forward with respect to each other, being actuated by kicker or rocking bars. This motion carries the fuel down the grates to the rear or center. All this time combustion is taking place, coking and the burning of volatile gases occurring while the coal is on the upper parts of the grate. When the fuel has been carried to the clinker crusher or dumping device at the bottom of the grate or grates, it should have been completely burned and should then be ready for discharge as ash. Overfeed stokers are adaptable to the firing of coking varieties of coal due to the motion of their grates which keeps the fuel bed porous and broken up, thus preventing caking or the formation of clinkers.

Underfeed Stokers involve the introduction of fresh coal beneath the fuel bed by means of steam or electric driven rams or plungers. The coal is usually delivered through a gravity feed hopper to the several retorts in which these rams or plungers operate. Essentially these retorts are individual primary combustion chambers, the sides being either stationary or subject to reciprocating motion. These sides also serve to carry the tuyeres or air grates, the latter consisting usually of a number of superimposed perforated plates.

As fresh coal is fed into the retorts it is gradually forced underneath the fuel bed by the action of either the plunger alone or a number of automatic auxiliary distributing pushers or plungers. This movement of the base of the fuel bed, together with the continued air blast which is delivered through the tuyeres, insures against caking or any tendency towards dirty fires. The volatile gases are driven off as the fresh coal becomes hotter and hotter through its proximity to the fuel bed above, being burned as they pass through this heated area; the green coal meanwhile becomes gradually coked and ultimately burned completely.

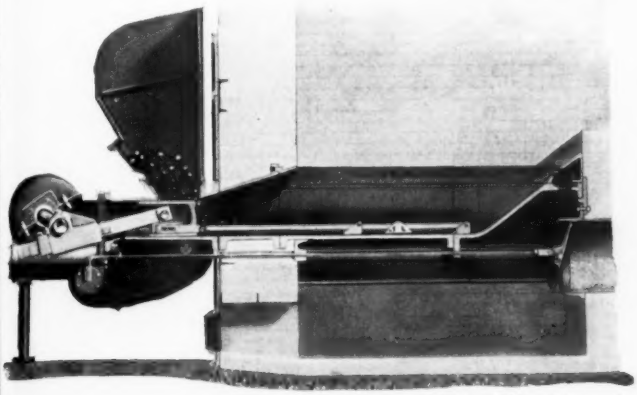
The Chain Grate or Traveling Stoker involves an endless chain which passes over suitable sprockets at the front and rear of the furnace, the meshed link or bars of this chain



Courtesy of Westinghouse Electric and Manufacturing Co.

Fig. 3.—Line sketch illustrating the details of construction of a typical overfeed type of stoker. Note automatic hopper and feed mechanism to the left.

serving as the grate or fuel bed. This chain is in motion continuously, passing round and round through the furnace, taking fresh fuel at the front end of the furnace and discharging the residual ash at the rear, as the chain turns over the sprockets. The necessary sprockets are fastened to suitable shafts which are part of the base frame of the stoker. Either the front or rear sprocket can be used as the driving element by suitable connection to a worm reduction gear mechanism, which in turn may be either driven by a steam engine or electric motor.



Courtesy of Detroit Stoker Co.

Fig. 4.—A multiple retort stoker of the underfeed type. Fuel hopper, coal ram, driving gear and push rod are clearly in evidence. The line of slots above indicates the air tuyeres. Uniform distribution of air permits a thin fuel bed and low air pressure; note chain drive in cut-away casing.

Coal is fed by gravity to the chain grate stoker in much the same manner as to the other types mentioned above; usually a suitable hopper is installed for this purpose at the front end of the furnace. The necessary air for combustion is delivered through the chain grate via either one or more distributing compartments below the top grate.

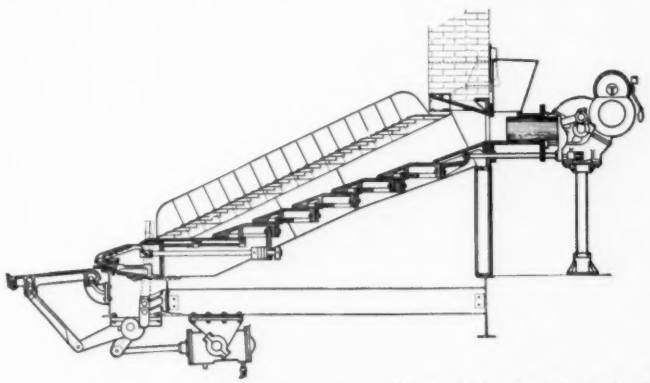
STOKER DRIVES

In order to manipulate the grates of the overfeed stoker, operate the plungers and rams of the underfeed machine, run the chain grate at the desired speed and turn the clinker grinder, it is essential to use some form of reduction geared power unit. This is commonly either a small vertical reciprocating steam engine, a turbine or an electric motor. The several types of stokers on the market vary considerably in their methods of handling fuels just as they vary in regard to their driving mechanisms.

In the overfeed stoker the feature of operation is the rocking or reciprocating motion to which the grates are subjected. This is brought about by means of a kicker bar or rocker which receives its reciprocating motion from the driving unit through a crank, eccentric connection, or a series of toggle levers.

The underfeed stoker in general depends upon the reciprocating action of the plunger in the charging of fresh fuel and the pressure of the air blast, for the agitation of the fuel bed. Therefore, the essential operating mechanisms involved are the plunger and the coal feeding devices. The plungers and distributing rams are usually connected to the driving unit through a suitable crank shaft of heavy construction. The driving unit can also be further connected through crank, link or rod mechanisms to operate a clinker grinder if necessary, and also the reciprocating overfeed grates and retort side bars in some types of stokers. As a result a regular sequence of operation is maintained in all the necessary moving parts just as long as the driving unit is running and the proper connections are maintained.

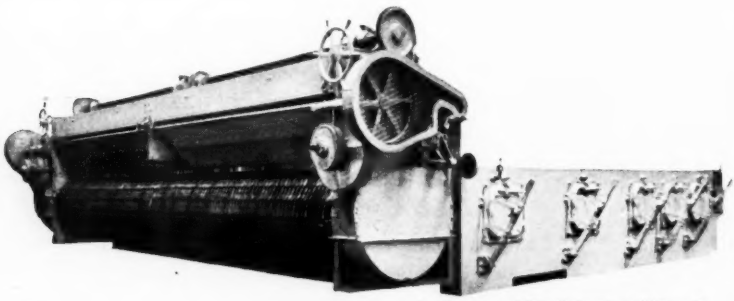
The principle operating part in the chain grate stoker is the driving mechanism. As has already been stated this may be attached to either the front or rear sprocket shaft through suitable reduction gearing. Additional mitre gears in connection with adjustable ratchet mechanisms are also used on some



Courtesy of American Engineering Co.

Fig. 5.—Line sketch of an underfeed type of mechanical stoker showing the reciprocating distributing rams in heavy detail, the planetary spur gear powerbox, the main ram and the general arrangement of the ash dump mechanism.

front feed stoker drives for the purpose of regulating the coal feeding device. In other types a hand-wheel operated worm and gear device is used for the controlling of the coal feed from the hopper onto the stoker chain. The sprocket shafts are carried in pedestal bearings of suitable size and construction to meet the wearing conditions and enable proper lubrication.



Courtesy of The Babcock & Wilcox Co.

Fig. 6.—View of a chain grate stoker showing grates in course of passage over the front sprocket, the regulating and control mechanisms, etc. An advantage of this type of stoker is that the entire device can be readily removed from the furnace for repair or inspection without disturbing the boiler or setting.

STOKER LUBRICATION

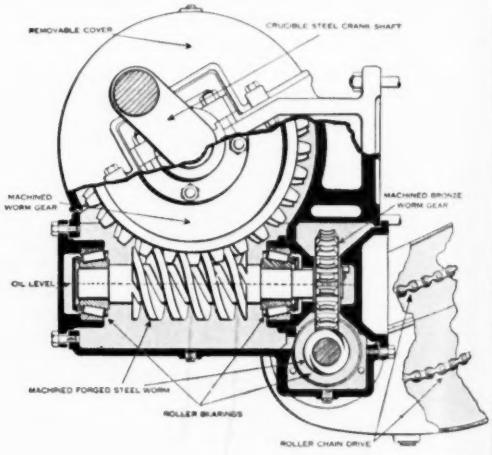
We have therefore certain definite details in every type of stoker which will require lubrication, i.e., there are the worms and gears, the miscellaneous bearings of the accessory connections which serve to operate the movable grates, etc., the pedestal and other more important bearings of both chain grate and underfeed stokers and the driving engines, turbines or motors. As a result, stoker lubrication can be discussed from three broad viewpoints, viz.: as applying to reduction gears, bearings and steam cylinders.

While many of the moving parts of any type of automatic stoker are exposed to a certain amount of heat, such connections as require lubrication are generally subject to far lower temperatures, although these latter may often be sufficiently high to render lubrication a serious problem. Bearings of movable grate connections as a rule will be chiefly affected in this respect. Other operating parts being outside the furnace receive only the heat of radiation from the boiler.

Reduction Gears

Worm and spur gears are the main parts which must be lubricated. According to the make of stoker, the worms may be located either above or below the main driving gears. As a result, their lubrication requires consideration from two angles. Stokers normally run at low speeds due to the gradual rate at which the coal must be fed. As a result large speed reductions are used especially where the prime mover is a turbine or an electric motor. The selection of the lubricant for a stoker worm drive should be based primarily upon the type of gear casing installed. In other words an oil tight casing will enable the employment of bath lubrication and the use of a lubricant of just sufficient viscosity to preclude wearing of the teeth. Where but a safety gear shield or an open or leaky case is involved, naturally we must turn to the heavier, more plastic grades of lubricants.

Essentially a worm gear installation will require a comparatively heavy, adhesive lubricant which will not wipe off the teeth when subjected to the combined sliding and rolling action of the teeth. Furthermore, in many installations the same lubricant must not only serve to lubricate the gears but also the worm shaft thrust bearings. Inasmuch as the lubricating requirements will differ considerably, in such cases it will be necessary to compromise and use a lubricant as suitable to both as possible. Usually a straight mineral product of about the consistency of steam cylinder oil will meet these conditions.

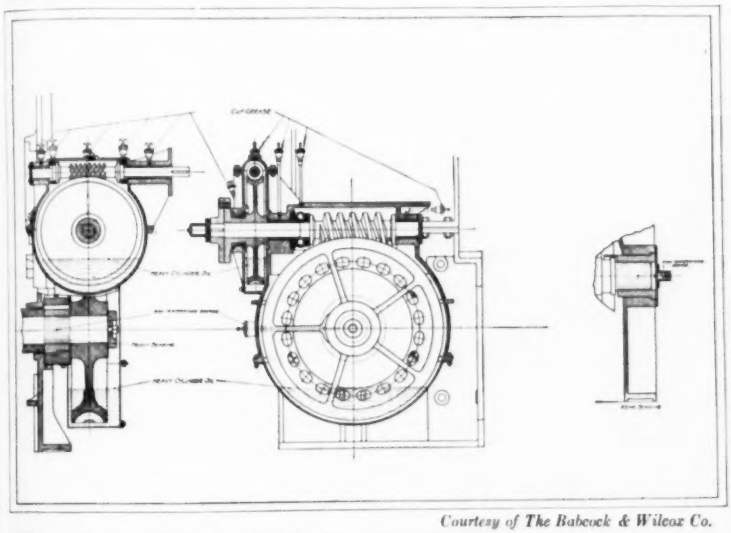


Courtesy of Detroit Stoker Co.

Fig. 7.—A stoker drive wherein the worm is located below the main gear. This arrangement readily permits of bath lubrication, using a relatively light bodied gear lubricant. Note the thrust roller bearings which are installed in connection with the worm shaft. This drive is fully enclosed.

The location of the worm with respect to the gear is important not only from the viewpoint of selection of the grade of lubricant, but also as to the manner of lubrication. When the worm is located below the gear it should be sub-

merged to approximately the center line of the worm shaft. This will insure the transference of sufficient lubricant to the gear teeth as they mesh with the worm. This condition does not occur to the same extent, however, when the worm is above the gear, due to the lower surface area of the gear teeth, and the fact that the lubricant will tend to travel along the worm shaft and drip down outside the trough. Also, especially when the stoker is first started up will there be a possibility of an insufficient film of lubricant being carried by the gear teeth to the worm. To forestall these conditions, it is advisable to run the gears submerged to the full depth of their lower teeth in a bath of lubricant, and use a highly adhesive, though relatively fluid, product which will stick tenaciously to the worm teeth and not drip off even where radiated heat may be relatively high.



Courtesy of The Babcock & Wilcox Co.

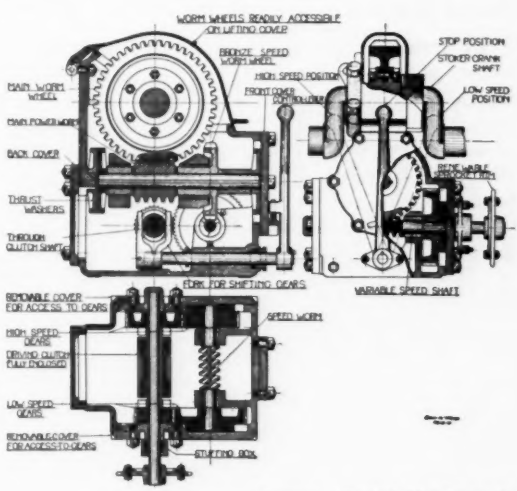
Fig. 8.—A worm reduction geared stoker drive wherein the worm is located above the main gear. This design is also enclosed in an oil-tight casing, hence permitting of bath lubrication. All bearings are grease lubricated as indicated.

When worm drives are not enclosed in an oil-tight casing bath lubrication is usually precluded, and it becomes necessary to apply the lubricant by hand, in heated condition, by means of a brush. In such instances the lubricant must be of considerably higher viscosity than specified above since it must maintain a suitable film on the teeth for the usual considerable period of time which elapses between applications. Low viscosity oils or non-adhesive greases will drip off when thinned down under the higher temperatures encountered. For such gears it is therefore advisable to use a straight mineral gear lubricant of approximately 1000 Sec. viscosity Saybolt at 210 deg. F. Dirt and dust must also be considered when lubricating worm reduction gears of this nature. Therefore, frequent attention should be given to cleaning the entire mechanism, otherwise excessive wear may occur due to the presence of abrasive material in the lubricating film on the teeth.

Bearings

Bearings in a stoker installation are internal and external in location. Internal bearings usually get little or no lubrication; in fact they are generally built with relatively high clearances, to operate without oil. The amount of motion to which they are subject is relatively slight, as is also the comparative rubbing speed. Therefore, heat conditions are really the only detriments involved.

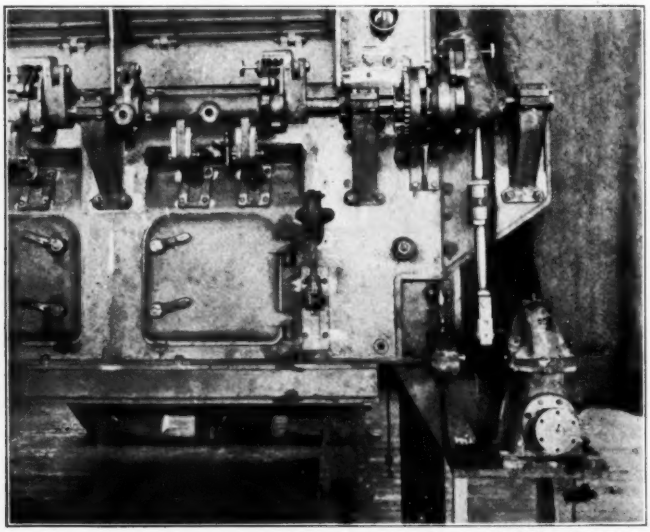
External bearings, however, should receive careful attention. Frequently they are designed for grease lubrication, being equipped with suitable grease cups. These latter are advantageous in that they are usually dustproof and insure a supply of clean lubricant to the bearing surfaces. Grease also tends to work out toward the end of the bearing, thus preventing the entry of dust along the shaft. For such service a medium bodied compression cup grease free from thickeners or non-lubricating adulterants will function best.



Courtesy of Sanford Riley Stoker Co.

Fig. 9.—A two-speed reduction gear mechanism wherein double the usual range of speed is obtained. All gears run in a bath of lubricant the bottom of the gear case forming a suitable reservoir.

It is perfectly possible, however, to lubricate stoker bearings with oil and this is often done where it is desirable to use one product for the external bearings of both the prime mover and the stoker. In such cases a medium viscosity engine oil of about 300 sec. viscosity Saybolt at 100 deg. F. will be suitable.



Courtesy of McClave-Brooks Co.

Fig. 10.—Front view of a mechanical stoker showing worm reduction gearing enclosed in an oil-tight casing, the mechanical timer with four-speed reduction, and the kicker bar operating mechanism with driving rod.

Prime Movers

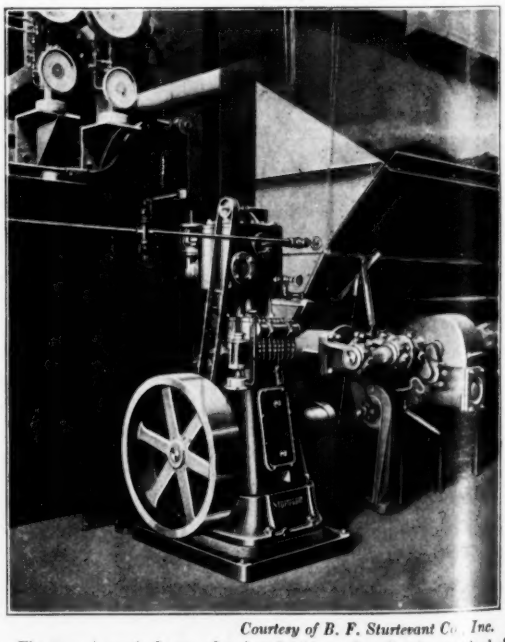
In general the above will include steam engines, steam turbines, electric motors, silent chain drives, or in certain cases, line shafting and belts. The lubrication of such equipment has been extensively dealt with in recent issues of LUBRICATION. *Therefore reference is made to those articles.

Certain types of stokers may be equipped with vertical, reciprocating, enclosed crankcase steam engines, usually of the single acting type. In this event a few words of detail regarding their lubrication will be of interest.

In the lubrication of these engines the design not only does not aim to prevent the entry of water but actually makes use of this latter as a carrier for the oil. During the process of lubrication the oil in the crankcase not only serves the bearings but also the cylinder walls to a partial extent, cooperating in this latter with the oil which is fed with the steam. To obtain effective lubrication the crankcase must be filled with water (preferably condensate) to the level of the overflow pipe. On top of this body of water is carried a $\frac{1}{8}''$ to $\frac{1}{2}''$ film or layer of specially refined lubricating oil. As the crank disc dips into this the requisite amount of lubricant is thrown to the cylinder walls, and internal bearings. The purpose of using a mixture of oil and water for lubrication is to enable the attainment of a more effective distribution of the oil than were the latter used alone.

Thereby, too, it is possible to bring about lubrication of both cylinders and bearings by means of one oil, and that a heavier product than would normally be used for other splash feed systems. Usually this oil must have a viscosity in the neighborhood of 100 sec. Saybolt at 210° F. Furthermore, it must separate readily from water, yet it must have sufficient adhesive ability to render it capable of clinging to the cylinder walls in the presence of water. Emulsification to a slight extent does no harm, but there is always possibility of repeated churning causing thick emulsions or "livering," especially if too much oil is used or if it has not been sufficiently carefully refined and prepared. Emulsions will naturally tend to render the lubricating system inoperative.

Main bearings of such engines are usually lubricated by sight feed oil cups or compression grease cups. The steam in turn is lubricated as necessary through hydrostatic or



Courtesy of B. F. Sturtevant Co., Inc.

Fig. 11.—A vertical type of stoker driving engine showing method of connection to the stoker proper, and the means installed for lubrication.

*November, 1923; April, 1924.

force feed oilers using oftentimes the same grade of oil as in the crankcase.

CONCLUSION

While we have touched but briefly upon this most important feature of steam power plant operation,—the lubrication of the automatic stoker,—enough stress has been laid upon the construction, design and the operating features involved, to indicate the importance of proper and sufficient lubrication. Upon the operation of the stoker will depend our rate of steam production. Therefore, even though our stoker may be apparently rugged and seemingly immune from lubrication difficulties, it will pay to give it careful attention and remember that it is quite as deserving of the best grades of lubricants as the other operating units in the plant.

Care and Handling of Hydrostatic Lubricators

WHILE considerable discussion of steam cylinder lubrication and the details of construction of the hydrostatic lubricator have been brought out in recent issues of LUBRICATION*, little has been said in regard to the practical care and handling of this device and the installation of cylinder oil atomizers. Therefore, to fittingly complete this matter these details require consideration.

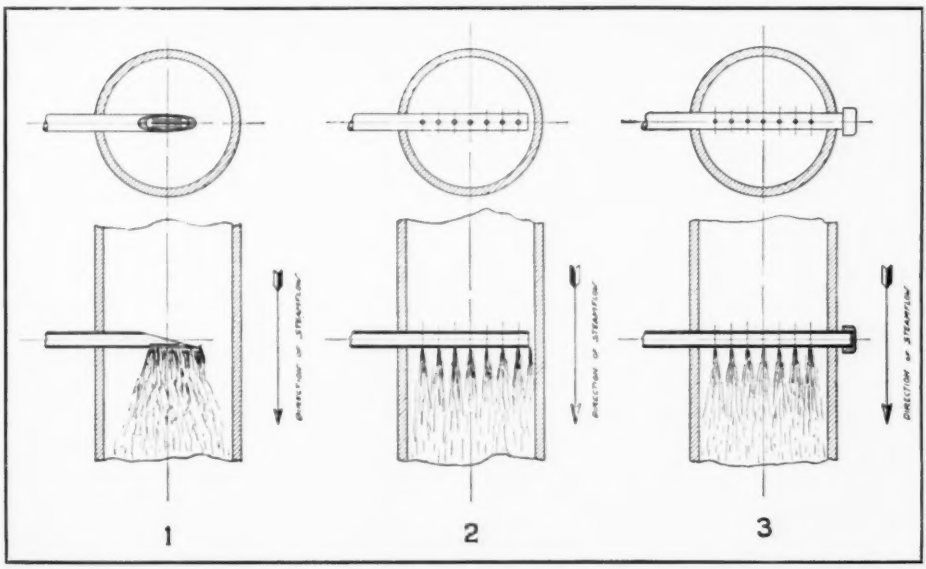


Fig. 1.—The spoon-shaped atomizer. This is an exceedingly satisfactory type of atomizer serving to break up the oil effectively.
Fig. 2.—The perforated type of atomizer which makes use of a number of perforations in the nipple through which steam is able to pass, thereby carrying oil out with it in the form of a spray.
Fig. 3.—Another type of perforated atomizer which is extended through the steam pipe and capped at the outer end. Cleaning out is thereby materially facilitated. Some engineers prefer to use a valve instead of a cap at this end to permit blowing out with steam with the least amount of trouble.

In many power plants today steam cylinders will be individually lubricated by means of the hydrostatic lubricator, either of the single or double connection type, attached to the steam supply piping of the engine, pump or compressor which is to be lubricated. Ostensibly this is a relatively simple piece of equipment. Practically, however, there are certain "kinks" involved in its operation, which many engineers will have but little opportunity to learn, unless they make a comprehensive study of valve and cylinder lubrication, or take up this equipment with the manufacturers in considerable detail.

As we all know, the principle of steam cylinder lubrication is based upon the feeding of a certain amount of specially refined lubricant (according to the nature of the steam and type

*November, 1923, April, 1924.

of engine) into the steam in such a manner and at such a point that this lubricant will have become finely atomized and uniformly distributed throughout the steam by the time the latter reaches the wearing surfaces of the valve chest and cylinder walls. To attain this, there are certain factors which must be considered, viz.:

(a) The location and attachment of the lubricator.
(b) The method of oil atomization.
(c) Filling of the lubricator.
(d) The principles of operation, and
(e) The care required.

converted to the double connection type. The length of the pipe which connects the top of the condenser bulb to the steam line attachment should be from eighteen inches to three feet (or even longer) in order to insure a sufficient supply of water to develop the necessary hydraulic pressure and cause a constant and regular flow of lubricant through the discharge connection to the atomizer. Since the steam pressure is equalized at both points of attachment it can be appreciated that it is the pressure brought about by condensation and water displacement, which actually forces the oil into the steam line.

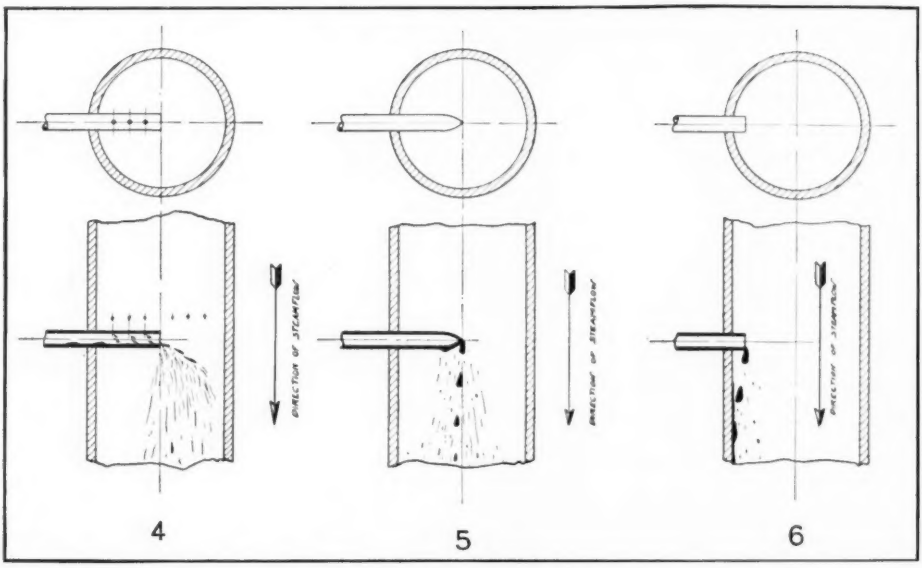


Fig. 4.—The perforated atomizer can also be constructed with holes on the top side only, the steam making two right-angular turns as shown. Oil is claimed to be effectively atomized by this procedure.
Fig. 5.—A drip type of atomizer in which the end within the steam line is drawn down to form an orifice.
Fig. 6.—In this type of installation the extent to which atomization may occur is questionable. The further in toward the center of the steam pipe that the nipple extends, the more chance will there be for the oil drops to be broken up by the action of the steam.

LOCATION AND ATTACHMENT OF THE LUBRICATOR

Due to the fact that not only the extent to which atomization will occur, but also the selection of the grade of lubricant will be affected by the position of the lubricator feed pipe, this naturally is a matter of importance. Good practice dictates that the oil should be fed to the steam line at a point between the boiler and throttle valve, preferably within four to eight feet of the latter. The independent acting type of hydrostatic lubricator is preferably attached to the steam line at two points, one above the device and the other at the point of oil discharge. Single connection lubricators are, however, frequently used. Where necessary they can often be readily

METHOD OF ATOMIZATION

While the efficiency of the lubricator and the selection of the oil will naturally have considerable bearing upon the extent to which satisfactory lubrication will be attained, the ultimate factor in this phase of engine operation will be the actual manner of introduction of the oil into the steam.

Inasmuch as the average hydrostatic lubricator merely serves to feed the oil into the steam line, it is necessary to install a suitable atomizer which will insure effective breaking up of the oil before it enters the steam chest and cylinders. Atomizers are only effective however, provided that they are properly designed and installed. Erroneous construction or careless installation may frequently defeat any

possibility of satisfactory lubrication, and oil will be consumed in a relatively useless manner due to the fact that little if any of it is able to reach the valve seats or cylinder walls in suitable condition to function properly.

There are, in effect, two types of atomizers used today in power plant service. Essentially each comprises a short length of pipe or a nipple inserted in the steam pipe, its outer end being connected to the lubricator delivery pipe. Fig. 1 shows what is known as the spoon type of atomizer. This is simply a piece of pipe or nipple of the same size as the lubricator discharge, and of such a length that when inserted in the steam pipe the tip will extend somewhat beyond the center line of the latter. Both ends of the nipple should be threaded; one end with a standard length thread, the other with a long enough thread to permit it to be screwed into the steam pipe as above. The upper part of the long thread end of this nipple should be cut away on such an angle that the remaining section will have sufficient curvature to allow for the cutting of one or more slots parallel to the axis and from one to two inches long. The tip of this nipple should be bent to a spoon-shape, the slots preferably terminating at a sufficient distance from the end to insure against loss of rigidity, although many engineers prefer to cut them through to the tip with a hack-saw. When inserting into the line, the top-side center of the atomizer should be clearly and permanently marked for it is important that the slots be directly lined up with respect to the travel of the steam; otherwise subsequent atomization will be impaired and the steam may be unequally lubricated. If by any chance such an atomizer is installed up-side down relatively no atomization will occur, the oil simply dripping from the nipple. It is the action of the steam, impinging on the oil as it flows out along the exposed portion of this nipple and forcing it through the slots, which brings about the necessary atomization.

Another type of atomizer (Fig. 2) makes use of a number of perforations in the nipple instead of slots, for the purpose of atomization. In this case, the nipple is usually not cut away, but remains intact, being drilled uniformly along the top and bottom (with respect to the axis) over perhaps a distance of two-thirds to three-quarters of the steam pipe diameter, with a sufficient number of equally spaced $\frac{1}{8}$" to $\frac{1}{4}$" holes. The top holes should preferably be somewhat enlarged. The nipple may or may not be threaded over its entire length according to the way it is to be installed and attached to the lubricator fitting. Some engineers find it advisable to weld or plug up the end of this nipple which is inserted into the steam line. Others carry it through to the opposite side of the steam pipe as shown in Fig. 3. This type of atomizer should be quite as carefully installed as the spoon-shaped device, and every care should be taken to see that the holes are directly in line with the direction of flow of the steam in order that the latter may blow through and carry the oil out in a spray. If by chance it is so installed that the perforations point towards the walls of the steam pipe, the steam may not pass through, atomization will not be effected and the atomizer will simply become a dripping device. Atomizers of this type are not always effective even when properly installed due to the possibility of the holes becoming plugged up. Another type of perforated atomizer has

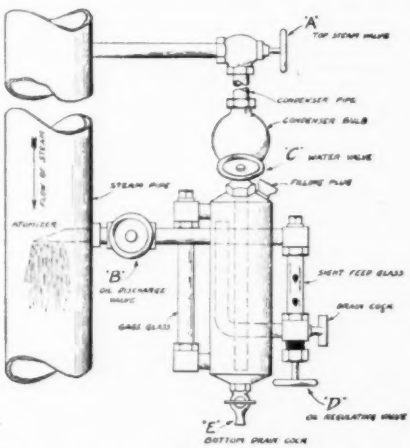


Fig. 7.—Line sketch of a typical double connection type of hydrostatic steam cylinder lubricator, showing essential features of construction and means for adjustment, etc.

holes drilled in the top of the nipple only, the steam making a turn and carrying the oil out through the end as in Fig. 4. In its installation the same care should be exercised as above.

Essentially, these are the only practical types of steam cylinder oil atomizers in use. Others (as in Figs. 5 and 6) which consist of an open ended nipple, or a nipple drawn down to an orifice, and inserted into the steam pipe so that the oil just flows out into the steam, are really dripping devices. Whether much atomization actually occurs when oil is thus allowed to drip into a volume of high velocity steam is often a question. Frequently, the drops of oil will be swept to the walls of the pipe to simply run down perhaps as far as the throttle valve.

While we have discussed the matter of atomizers as part of this chapter on hydrostatic lubricators, it must be borne in mind that the oil atomizer is also a most essential

part of a force feed steam cylinder lubricator. When used with equipment of the latter type, the same principles of design and installation as discussed above will be applicable. Due to the variety of pipe sizes involved, but little attempt has been made to dwell upon the actual size of any of these types of atomizers. Rather, the discussion has been made general on purpose, in order to give the power plant engineer every opportunity to use his own good practical judgment in accordance with the tools available at hand.

FILLING THE HYDROSTATIC LUBRICATOR

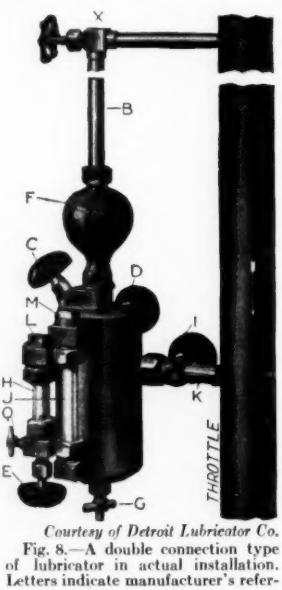
Now to return to the subject of the lubricator.

With a hydrostatic lubricator and atomizer installed and ready for service, the question of properly filling it with the oil is next of importance. First, valve "B" (Fig. 7) in the oil discharge pipe should be closed as well as water valve "C" which controls the hydrostatic pressure of the water in the condenser pipe. In this way, steam pressure is shut off from the lubricator itself. The filling plug should then be removed and the lubricator carefully filled with oil. When the lubricator is to be refilled the water should be drawn off before putting in new oil, by means of the bottom drain cock "E." After opening the drain cock remove the filling plug to hasten the flow.

OPERATION

To put the lubricator into operation after filling, valve "B" (Fig. 7) in the oil discharge pipe should be opened as well as the water regulating valve "C" adjacent to the condenser bulb. The flow of oil can then be adjusted to the proper rate by means of the regulating valve "D" located below the sight feed oil glass, passing to the atomizer and steam pipe through the lubricator discharge pipe. When a lubricator is to be started, at least five minutes should elapse after steam has been turned on, by means of the top and bottom regulating valves, before attempt is made to open or adjust the oil regulating valve. This is to allow sufficient steam to enter and condense in the lubricator and completely fill the reservoir space such as the sight feed glass and condensing chamber which are not occupied by the oil. If this precaution is not taken, "churning" will occur due to lack of a sufficient volume of water in the lubricator, steam flowing in and mixing with the oil to churn it to a foam. In such event globules of oil will be deposited on the walls of the sight feed glass. If this occurs, all valves of the lubricator should be closed as when filling. It should then be allowed to cool and completely drain. If necessary the sight feed glass should be blown through with steam to thoroughly clean it, as explained hereafter. Then the lubricator should be refilled with new oil and the formation of sufficient condensate allowed for to prevent the re-occurrence of such "churning." When a lubricator is to be temporarily turned off however, over any normal period of engine shutdown, it will only be necessary to close the adjusting valve "D" below the sight feed oil glass and the oil discharge valve "B."

Size of Oil Drops—If the oil drops appear to form entirely too large during operation, but still not large enough to burst or strike against the side of the sight feed oil glass, this may be often overcome by filling the sight feed glass with a solution of water containing about a teaspoonful of common table salt. Increasing the specific gravity of the liquid in the glass causes the oil drops to break away from the feed cone more readily and before they have time to become too large. The cause of the formation of oversized oil drops is often however, due to accumulation of dirt around the top of the oil feed cone. Where this becomes excessive and if it is not corrected, the glass may fill with oil on account of drops bursting or striking against the side of the former in their upward course. If this occurs, the lubricator should be shut off, the sight feed glass removed, the top of the feed cone thoroughly cleaned, and its top surface smoothened if necessary.



Courtesy of Detroit Lubricator Co.

Fig. 8.—A double connection type of lubricator in actual installation. Letters indicate manufacturer's references.

Cleaning the Sight Feed Glass—Dirt or oil deposits can be cleaned from this glass either by blowing steam through it or swabbing with a piece of lintless cloth. To do this the plug at the top should be removed, and a piece of cloth wrapped around a thin stick, soaked in kerosene and used as a swab. Shreds should never be allowed to catch on any metallic parts of the interior for they will cause trouble during subsequent operation.

When it is desired to clean the glass by blowing steam through it, the oil regulating valve "D" (Fig. 7) should be closed, the sight feed glass drain cock in the bottom setting opened and valve "B" in the oil discharge pipe

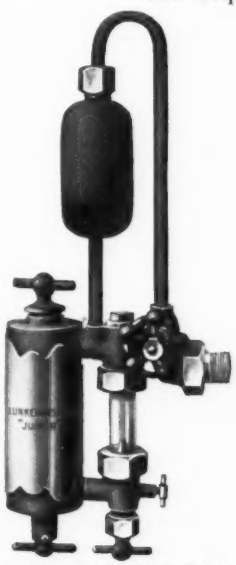
opened. By this procedure, steam can be blown through the glass to clean it effectively.

CARE OF THE HYDROSTATIC LUBRICATOR

Leaks—Leaky connections should be corrected promptly as they will often cause irregular feeding of the oil.

Gaskets and *Sight Feed Glasses*—If the sight feed glass becomes clogged it may be due to the bottom nut having been set up too tightly when the glass was installed. This will often cause the gasket to be squeezed out of position or perhaps even into the glass. Should a glass become so clogged, it must be promptly removed and cleaned. In such a case it is not advisable to blow through with steam as this may force the obstruction into the orifice of the drain cock.

Common rubber gaskets or cut glasses should not be used in hydrostatic lubricators inasmuch as both have to withstand heat and steam, the latter having a tendency to rot out ordinary rubber gaskets. Furthermore, cut gauge glasses will often be broken or split at the ends due to alternate expansion and contraction. For this purpose, special fused end gauge glasses capable of withstanding heat, and gaskets made of a rubber-linen composition arranged in alternate layers should be used.



Courtesy of The Lunkenheimer Co.
Fig. 9.—A single connection type of hydrostatic lubricator showing the manner in which the condenser bulb is connected to the support arm through the equalizer tube.

Displaced Feed Cone—In case the oil feed cone becomes displaced or off center, globules of oil may be caused to move up the sides of the glass, perhaps sticking thereto, and ultimately causing the glass to fill with oil. When this occurs the glass should be removed and the cone carefully smoothened with a fine abrasive device. It may also be advisable to solder a thin copper wire to the side of the latter leading it up through the center of the glass, nearly to the top. The oil drops will follow this wire in their course upward and the possibility of sticking to the side of the glass will be eliminated. This wire, however, must be very fine and absolutely smooth, otherwise its use may cause trouble.

Empty Lubricators—A hydrostatic lubricator should never run empty of oil, for the sight feed and gauge glasses will thereby become hot, causing the final particles of oil to stick or gum to the sides, and rendering cleaning necessary.

Straining Cylinder Oil—Cylinder oils manufactured by reliable oil refiners will normally not require straining. Where there is any doubt as to cleanliness however, or when trouble has been traced to accumulations of dirt or foreign matter in the lubricator, the oil should be strained prior to use. Fine cheesecloth is effective for this purpose.

Outdoor Operation—A lubricator installed on a pump or engine operating exposed to the weather and low climatic temperatures, will often involve danger of the water freezing if the former is shut down normally. It is well, therefore on shutting down, to drain the water from the oil sight feed glass, the lubricator reservoir and condenser. The valves in the pipe line leading to the condenser, and in the oil discharge connection (support arm) should also be closed tightly to prevent leakage of steam and resultant condensation in the lubricator. Water freezing in such a lubricator may break the glasses or even bulge or burst the body of the lubricator.

CONCLUSION

While the hydrostatic steam cylinder lubricator is exceedingly adaptable to the single unit, etc., yet it should be borne in mind that it is an appliance whose dependability hinges to a great extent upon the care and attention given by the operator. As has been stated before, it is not automatic, and must be started, regulated and stopped by hand. When a small, slow feed is required, it has been found difficult to maintain this uniformly due to the changes in the viscosity of the oil by virtue of changes in temperatures. Therefore, both weather and engine room temperatures are factors which will require careful consideration from the operator if his lubricators are to function dependably.

Wick Feed Lubrication

A recent article which appeared in LUBRICATION on the subject of automatic lubrication dealt briefly with the construction and use of the wick feed lubricator. The fact that the majority of the other types of lubricators discussed were chiefly applicable to power plant equipment in general led to the treatment of the wick feed oiler from this angle as well. This device in its basic form is perhaps one of the simplest yet most effective types of relatively automatic lubricators in use today. Especially in the marine service has it made its mark, though naturally it requires more attention on shipboard where compounded oils may be used.

In view of the above it has been only natural that engineers should have directed their efforts towards the development in the industrial and automotive fields of variations of the original idea of wick feed lubrication. While the design of these various types has differed more or less from the basic idea, as will be noted from previous issues of LUBRICATION*, the principle of operation is essentially the same, involving either capillary attraction, or a combination of this latter with the action of the siphon. The former is present in the up-feed type of lubricator, wherein the oil passes upward through the pores of the wick of its own accord, motion of the journal being required to draw the oil away from the uppermost portion of the wick with which it is in contact. This type of wick feed oiler is absolutely automatic in that oiling starts and stops with the starting and stopping of the shaft or journal. Therefore, there is no chance of wastage of oil during shut-down periods; yet the wick remains saturated and ready for immediate service just as long as there is oil in the reservoir.

Where the action of the siphon is included in the design of any wick feed lubricator, however, or where oil feed is downward, some provision must be installed to stop the flow of lubricant over periods of shut-down, or else the wick must be withdrawn from the oil lines; otherwise the oil in the reservoir will continue to flow until it has all been siphoned over to the bearings. Naturally this is a direct waste. This has been realized by industrial and automotive engineers, with the result that they have developed certain types of wick feed lubricators which are practically automatic in action, requisite of a minimum of attention and decidedly economical as regards the matter of oil consumption.

We must remember, however, that these devices, while admirable for certain service and highly endorsed by their designers, are not absolutely foolproof, nor applicable to all types of machinery. For example, no one would normally think of using a wick feed lubricator on a steam turbine bearing. In fact it may be safely stated that within the limitations of their adaptability the efficiency of wick feed lubricators will depend to a large extent upon the original purity of the oil used and the cleanliness of the system. For example, dirt in the oil reservoir or the use of a cheap, low-grade oil which may contain contaminating foreign matter to any extent, will most surely result in the ultimate cessation of lubrication. It is claimed that the wick serves as a filter to insure the transmission of clarified oil to the bearing. Very true! But if we clog up this filter with dirt, carbon, or other foreign matter, it naturally follows that the passage of oil will thereby be reduced or even stopped. It is for this reason that careful marine engineers observe such caution as the periodic stripping of wicks in their wick feed oilers. Here the prevalent use of compounded oils will quickly lead to gumming and hardening of that part of the wick exposed to the air, unless this gummy matter is removed at frequent intervals.

Therefore, the grade of oil used in any type of wick feed oiler may be said to be indicative of the ultimate success we may expect from such a device; provided the basic principles of construction are correct and the size of the oiler is adequate for serving the bearing in question. Under these conditions if a highly refined (preferably straight mineral) lubricant free from foreign matter is used, there is no reason why the lubrication attained thereby should not be practically automatic.

*December 1921, April 1924.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
47 West Street, N. Y. C.